CLAIMS

1. A process comprising:

pumping a liquid working fluid to an elevated pressure,

heating the liquid fluid to a high temperature and high-pressure gas,

expanding the high temperature and high-pressure gas through an expander to produce shaft work,

using the shaft work to drive an air compressor for compressing air and delivering compressed air to a fuel cell system component,

and removing energy from the working fluid gas to change the gas a to liquid.

2. A process as set forth in claim 1 further comprising using the shaft work to drive a pump for pressurizing and delivering cooling fluid to a fuel cell system component.

3. A process as set forth in claim 1 wherein the liquid working fluid comprises an organic based fluid.

4. A process comprising:

pumping a liquid working fluid to an elevated pressure,

heating the liquid to a gas using a heating source comprising a fuel cell stack,

expanding the through an expander to produce shaft work,

using the shaft work to drive an air compressor for compressing air and delivering compressed air to the fuel cell stack,

and removing energy from the working fluid gas to change the gas to a liquid.

5. A process as set forth in claim 4 further comprising using the shaft work to drive a pump for pressurizing and delivering cooling fluid to a fuel cell system component.

6. A process as set forth in claim 4 wherein the liquid working fluid comprises an organic fluid.

7. A process of heating a fuel cell stack during relatively cold startup conditions comprising:

a) pumping a fuel cell stack liquid cooling fluid to an elevated pressure,

b) transferring thermal energy between the fuel cell stack liquid cooling fluid and a fuel cells stack,

c) heating the liquid cooling fluid,

d) expanding the heated cooling fluid in an expander to produce shaft work,

e) using the shaft work to drive an air compressor for compressing air and delivering compressed air to a fuel cell stack,

f) directing the cooling fluid through a condenser wherein the condenser fans are turned off, and

repeating steps (a-f) until the temperature of the fuel cell stack has reached at predetermined temperature suitable for operating fuel cell under post startup operating conditions.

8. A process as set forth in claim 7 further comprising using the shaft work to drive a pump for pressurizing and delivering cooling fluid to a fuel cell system component.

9. A process as set forth in claim 7 wherein the cooling fluid comprises an organic fluid.

10. A process of heating a fuel cell stack during relatively cold startup conditions and thereafter cooling the fuel cell stack during post startup operations, and using waste heat generated by the fuel cell stack during post startup operation to produce shaft work comprising:

a) pumping a fuel cell stack liquid cooling fluid to an elevated pressure,

b) transferring thermal energy between the fuel cell stack liquid cooling fluid and a fuel cells stack,

c) heating the liquid cooling fluid,

d) expanding the heated cooling fluid in an expander to produce shaft work,

e) driving an air compressor with the shaft work to compress air and delivering compressed the air to a fuel cell stack,

f) directing the cooling fluid through a condenser wherein the condenser fans are turned off, and

g) repeating steps (a-f) until the temperature of the fuel cell stack has reached at predetermined temperature suitable for operating the fuel cell under post startup conditions and wherein operation of the fuel cell stack produces waste heat, and

h) after the temperature of the fuel cell stack has reached at predetermined temperature suitable for operating the fuel cells stack under

post startup conditions, turning on the condenser fans so that heat is removed from the cooling fluid gas to change the gas to a liquid, and

i) pumping the fuel cell stack a liquid cooling fluid to an elevated pressure,

j) transferring thermal energy between the fuel cell stack liquid cooling fluid and the fuel cell stack to cool the fuel cell stack and to heat the liquid cooling fluid,

k) supplying additional heat to the liquid cooling fluid to change the liquid to a gas,

l) expanding the heated cooling fluid gas through an expander to produce shaft work,

m) driving an air compressor use in the shaft work to compress air and delivering the compressed air to a fuel cell stack,

n) directing the cooling fluid through a condenser to remove heat from the gas and change the gas to liquid, and

repeating steps (i-n) .

11. A process as set forth in claim 10 wherein the step of heating the cooling fluid in step c) is conducted by directing the cooling fluid through a first heat exchanger in the fuel cell stack and through a second heat exchanger connected to a second heat source.

12. A process as set forth in claim 11 wherein the second heat source comprises a catalytic combustor.

13. A process as set forth in claim 11 wherein the step (k) of supplying additional heat to change the liquid to a gas comprises supplying heat from the exhaust of a catalytic combustor to change the liquid to a gas,

and further comprising a step of supplying additional heat sufficient to super heat the gas.

14. A process as set forth in claim 10 wherein the cooling fluid comprises an organic fluid.

15. A process of heating a fuel cell stack during relatively cold startup conditions and thereafter cooling the fuel cell stack during post startup operations, and using waste heat generated by the fuel cell stack during post startup operation to produce shaft work comprising:

a) pumping a fuel cell stack liquid cooling fluid to an elevated pressure,

b) transferring thermal energy between the fuel cell stack liquid cooling fluid and a fuel cells stack,

c) heating the liquid cooling fluid,

d) expanding the heated cooling fluid in an expander to produce shaft work,

e) driving an air compressor with the shaft work to compress air and delivering compressed the air to a fuel cell stack,

f) using the shaft work to drive a pump for pressurizing and delivering cooling fluid to a fuel cell system component,

g) directing the cooling fluid through a condenser wherein the condenser fans are turned off, and

h) repeating (a-g) until the temperature of the fuel cell stack has reached at predetermined temperature suitable for operating the fuel cell under post startup conditions and wherein operation of the fuel cell stack produces waste heat, and

i) after the temperature of the fuel cell stack has reached at predetermined temperature suitable for operating the fuel cells stack under

post startup conditions, turning on the condenser fans so that heat is removed from the cooling fluid gas to change the gas to a liquid, and

j) pumping the fuel cell stack a liquid cooling fluid to an elevated pressure,

k) transferring thermal energy between the fuel cell stack liquid cooling fluid and the fuel cell stack to cool the fuel cell stack and to heat the liquid cooling fluid,

l) supplying additional heat to the liquid cooling fluid to change the liquid to a gas,

m) expanding the heated cooling fluid gas through an expander to produce shaft work,

n) driving an air compressor use in the shaft work to compress air and delivering the compressed air to a fuel cell stack,

o) using the shaft work to drive a pump for pressurizing and delivering cooling fluid to a fuel cell system component,

p) directing the cooling fluid through a condenser to remove heat from the gas and change the gas to liquid, and

repeating (j-p) .

16. A fuel cell system comprising:

a cooling fluid,

a pump for pumping the cooling fluid in a liquid state to an elevated pressure,

the pump being connected to a heat generating fuel cell system component,

the heat generating component being constructed to transfer heat to the cooling fluid and change the fluid to a gas,

the fuel cell being connected to an expander to deliver the heated high-pressure cooling fluid to the expander,

the expander being constructed to produce shaft work from the fluid flowing therethrough,

the expander being operatively connected to a second fuel cell system component to use the shaft work generated by the expander,

the expander being connected to a condenser to deliver the fluid to a condenser,

the condenser being constructed to remove heat from the fluid and to change the fluid to a liquid,

the condenser being connected to the pump to deliver the liquid fluid to the pump.

17. A system as set forth in claim of 16 wherein the heat generating component comprises a fuel cell stack.

18. A system as set forth 17 wherein the heat generating component comprises a catalytic combustor.

19. A system as set forth in claim 16 wherein the cooling fluid comprises an organic fluid.

20. A fuel cell system comprising:

a cooling fluid,

a pump for pumping the cooling fluid in a liquid state to an elevated pressure,

the pump being connected to a heat exchanger in a fuel cell,

the fuel cell being connected to an expander to deliver the fluid to the expander,

the expander being constructed to generate shaft work from the fluid flowing therethrough, and the expander being operatively connected to an air compressor to drive the air compressor and produce compressed air,

the air compressor being connected to the fuel cell to deliver compressed air to the fuel cell,

the expander being connected to a condenser to deliver the fluid to the condenser,

the condenser being constructed to remove heat from the fluid and to change the fluid to a liquid,

the condenser being connected to the pump to deliver the liquid cooling fluid to the pump.